Functioning after cardiothoracic surgery

ANNERIKE C. GOVERS1, BIANCA M. BUURMAN1, PETER JUE2, BAS A. J. M. DE MOL3, DAVE A. DONGELMANS4, SOPHIA E. DE ROOIJ1

1Section of Geriatric Medicine, Department of Internal Medicine, Academic Medical Center, PO Box 22660, Amsterdam 1100 DD, The Netherlands
2Department of Geriatrics, Rijnland Ziekenhuis, Leiderdorp, The Netherlands
3Department of Cardiothoracic Surgery, Academic Medical Center, Amsterdam, The Netherlands
4Department of Intensive Care, Academic Medical Center, Amsterdam, The Netherlands

Address correspondence to: Bianca M. Buurman. Tel: +31 205665991; Fax: +31 205669325. Email: b.m.vanes@amc.uva.nl

Abstract

Background: there is a growing demand for cardiothoracic surgery in patients’ aged ≥65 years.
Objective: to explore which variables were independently associated with functional decline 12 months after cardiothoracic surgery followed by intensive care admission.

Received 16 January 2014; accepted in revised form 17 March 2014
Design: prospective cohort study.
Setting: cardiothoracic unit of a university teaching hospital.
Subjects: a total of 356 elderly patients undergoing cardiothoracic surgery followed by intensive care unit admission.
Methods: functioning was assessed at hospital admission and 3 and 12 months after hospital discharge with the modified Katz activities of daily living (ADL) index. Data collection included demographics, surgical procedure, diagnosis, comorbidities, pre-morbid geriatric conditions and intensive care unit length of stay. Functional decline was defined as a one-point loss on the modified Katz ADL index score at 1 year compared with baseline functioning at hospital admission. Logistic regression analysis was performed to study the association between independent variables and functional decline.
Results: the 1-year mortality rate was 8.7% of which 4.8% was in-hospital mortality. The youngest group consisted of 295 patients (64% men; 72 ± 4 years), there were 61 octogenarians (56% men; 82 ± 2 years). One year after hospital discharge, younger patients demonstrated less functional decline (45 versus 56%, P < 0.001). Cognitive impairment, higher age, female gender, alcohol use, type of cardiac procedure and serum creatinine were independently associated with functional decline 1 year after discharge.
Conclusions: the survival rates after cardiothoracic surgery were good, the rates of functional decline were substantial. These results suggest that studies on geriatric rehabilitation before and after surgery might be needed to overcome the decline in functioning.

Keywords: functional status, hospitalisation, intensive care admission, geriatric, cognition, cardiothoracic surgery, functional decline, patient-reported outcomes, cognitive, older people

Introduction

Owing to the increase in life expectancy and the higher incidence of cardiovascular disease with advanced age, the number of elderly patients undergoing cardiothoracic surgery continues to rise [1]. Studies show that planned cardiothoracic surgery followed by an intensive care unit (ICU) admission has a good prognosis and outcome in terms of survival [2–6] and improved quality of life after successful cardiac surgery [4, 5, 7]. Although several studies have shown that daily functioning is a strong independent predictor of hospital outcomes [8, 9], several questions regarding the effects of cardiothoracic surgery on post-discharge functional decline remain unanswered.

For example, previous studies used a wide variety of definitions and sub-scales to determine functional decline after cardiac surgery [10–12]. Moreover, most studies did not prospectively measure daily functioning before cardiothoracic surgery and not much is known about the functional trajectory from baseline to 1 year after discharge [3, 5, 10].

We aimed to investigate differences in functional decline between patients 65–79 years of age and those older than 80 years of age undergoing cardiothoracic surgery followed by an ICU admission. Furthermore, we explored which variables were independently associated with functional decline up to 1 year after hospital admission.

Subjects and methods

This was a prospective cohort study of all consecutive patients aged 65 and older undergoing cardiothoracic surgery followed by an ICU admission between 1 December 2005 and 1 October 2007, with a 1-year follow-up in the Academic Medical Center (AMC) in Amsterdam, a 1,024-bed tertiary university teaching hospital in the Netherlands. We excluded patients who did not give informed consent or when the patient was unable to speak or understand Dutch. The Institutional Review Board of the AMC approved the study.

Patients admitted to the cardiothoracic surgery unit were pre-operatively screened for eligibility by one of our trained research nurses. Before inclusion, patients, or his or her closest relative in cases of cognitive impairment, provided written informed consent. Data collection included demographic and social data, marital status, living status at the moment of hospital admission and physical and cognitive functioning.

Physical functioning was measured using the modified Katz index score of activities of daily living (ADL) [13], a validated 15-item scale that measures the independence of the subject in basic and instrumental activities of daily living (ADL and IADL). The scoring system has a range of 0 to 15 points, and a higher score indicates more dependency in performing daily functioning. The Informant Questionnaire on Cognitive Decline short form (IQCODE-SF) [14, 15] was used to determine global cognitive impairment as rated by a close relative. Patients with a score of ≥3.4 on the IQCODE-SF were considered to have global cognitive impairment.

In the ICU, intensivists collected data concerning ICU admission, as part of the Dutch National Intensive Care Evaluation (NICE) registry. Details concerning the quality of the data used in this study have been published elsewhere [16]. We used ICU length of stay, highest serum creatinine concentration and Glasgow Coma Scale [17].

Cardiothoracic surgery interventions were divided into six major categories: coronary artery bypass grafting (CABG), aortic valve replacement or repair, a combination of the two previous interventions mentioned, mitral valve replacement or repair (MVR), a combination of CABG and mitral valve replacement and other.
Follow-up and definition of outcomes

All the patients alive at 3 months and/or 12 months after discharge (or their caregivers) were interviewed by phone by a research nurse. Functional decline was defined as a loss of at least one-point on the modified Katz ADL index questionnaire at 3 and 12-month follow-up compared with baseline functioning at hospital admission.

Statistical analyses

The study group was divided into two categories according to age: age 65–79 years old and age 80 years and older. Because the baseline data set showed some missing data on the independent variables (demographic variables and baseline physical and cognitive functioning), we performed multiple imputation as implemented by SPSS, version 18.0.2. Five imputation data sets were used. The independent impact of demographic variables, pre-morbid functional status and medical information on functional decline at 3 and 12 months was analysed using logistic regression. Univariate analysis was first performed to identify variables associated with functional decline. All variables with a P-value <0.20 were included in the multivariable analysis. All statistical analyses were performed using Statistical Package for Social Sciences (SPSS), version 18.0.2.

Results

During the study period, 521 patients underwent cardiothoracic surgery. In all, 120 patients (23%) were excluded. The mortality rate after 1 year was 8.7%, this included 4.8% in-hospital mortality. The mean age (± standard deviation) for the entire study population was 74 (±5) years. At baseline, 62% in the young age group and 38% in the oldest age group experienced no limitations on the modified Katz ADL index score. There were significant differences between the patients aged 65–79 and the patients older than 80 years according to social status, living arrangement, functional status and the different cardiac procedures that the patients underwent (Supplementary data available in Age and Ageing online, Appendix Table S1).

Functional trajectory from baseline to one year after discharge

Figure 1 shows the functional trajectories of the two age groups from baseline to 1 year after discharge. At 3-month follow-up, 45% of the patients in the group age 65–79 experienced a decline in their daily functioning compared with 56% in the patient group age 80 years and over. One year after surgery, the younger aged patients had better functional and mortality outcomes compared with the octogenarians.

Factors associated with functional decline 1 year after cardiothoracic surgery

Table 1 shows the logistic regression model for functional decline 1 year after cardiothoracic surgery. Older age, (OR: 1.07 (95% CI: 1.01–1.12)), female gender (OR: 2.18 (95% CI: 1.17–4.06)), current alcohol use (OR: 0.41 (95% CI: 0.25–0.67)).

![Functional decline at three and twelve months follow-up, compared to baseline](image-url)

Figure 1. Overview of trajectories of mortality and daily functioning in patients at 3 and 12 months after cardiothoracic surgery and ICU admission. The study population was divided into two age groups, and the data are shown for two different follow-up points. The two columns on the left represent follow-up at 3 months, and the two columns on the right represent follow-up at 12 months. A decline was defined as >1 point loss on the modified Katz ADL index questionnaire. *There were significant differences between the two age groups for all four different subgroups at 3- and 12-month follow-up (P-value of 0.036 and 0.004, respectively). †The numbers within the columns represent the percentage of patients with the corresponding functional trajectory.
0.24–0.70)), cognitive impairment at baseline (OR: 4.04 (95% CI: 1.23–13.21)), type of cardiac procedure (OR: 0.19 (95% CI: 0.06–0.60)) and a higher serum creatinine (OR: 1.02 (95% CI: 1.01–1.03)) were independently associated with functional decline at 1 year.

In Supplementary data available in Age and Ageing online, Appendix S2, the logistic regression model for functional decline at 3 months is presented. Higher age, female gender, cognitive impairment at admission, New York Heart Classification stage IV and a low Glasgow Coma score were all independently associated with functional decline at 3 months.

**Discussion**

This study demonstrates that older patients undergoing cardiothoracic surgery followed by ICU admission show high survival rates. Functional decline was, however, common. We found that patients aged 65–79 year had lower rates of functional decline compared with those older than 80 years. Older age, female gender, alcohol use, cognitive impairment at baseline, the type of cardiac procedure and kidney function defined by serum creatinine were independently associated with functional decline 12 months after the cardiothoracic surgery and ICU admission.

We demonstrated that in the group of octogenarians recovery from functional decline after cardiothoracic surgery seems to be uncommon. Other studies show contradictory results with regard to recovery from functional decline [5, 18, 19]. These contradictory results might be explained by the different definitions of functional decline. Most studies used a narrower definition of functional decline and applied schemes like the New York Heart Association (NYHA) functional classification [20] or the Seattle Angina Questionnaire (SAQ) [21]. Furthermore, in most studies, functioning was often measured retrospectively or cross-sectional [5, 11, 18].

We showed that a small portion of patients improved in ADL, but the percentage of functional decline found in both age groups appears to be much higher than observed in community-dwelling older persons [22]. This difference could be explained by the observation that our patients, already experienced more co-morbidity and IADL impairments, which are associated with the development of new disability [23]. Moreover, hospitalisation itself is a major risk factor for functional decline [24, 25]. Consistent with findings from other studies, we demonstrated that higher age is a risk

<table>
<thead>
<tr>
<th>Variable</th>
<th>Univariate</th>
<th>Multivariable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>P-value</td>
</tr>
<tr>
<td>Age (in years)</td>
<td>1.10 1.06–1.16 &lt;0.001</td>
<td>1.07 1.01–1.12 0.01</td>
</tr>
<tr>
<td>Female gender</td>
<td>1.57 0.98–2.52 0.06</td>
<td>2.18 1.17–4.06 0.01</td>
</tr>
<tr>
<td>Social status married</td>
<td>1.55 0.92–2.60 0.10</td>
<td>–</td>
</tr>
<tr>
<td>Body mass index</td>
<td>18.5–25 kg/m² Ref</td>
<td>–</td>
</tr>
<tr>
<td>&gt;25 kg/m²</td>
<td>1.78 1.11–2.88 0.02</td>
<td>–</td>
</tr>
<tr>
<td>&lt;18.5 kg/m²</td>
<td>3.52 0.31–39.92 0.31</td>
<td>–</td>
</tr>
<tr>
<td>Independent living arrangement</td>
<td>1.86 0.52–6.74 0.34</td>
<td>–</td>
</tr>
<tr>
<td>Education</td>
<td>0.94 0.87–1.01 0.08</td>
<td>–</td>
</tr>
<tr>
<td>Alcohol</td>
<td>0.41 0.26–0.67 &lt;0.001</td>
<td>0.41 0.24–0.70 &lt;0.01</td>
</tr>
<tr>
<td>Functional status at baseline (per point)a</td>
<td>1.12 0.96–1.32 0.16</td>
<td>–</td>
</tr>
<tr>
<td>Cognitive functioning at baseline (per point)b</td>
<td>5.16 1.70–15.69 &lt;0.01</td>
<td>4.04 1.23–13.21 0.02</td>
</tr>
<tr>
<td>Heart failure (NYHA class IV)</td>
<td>1.29 0.77–2.15 0.34</td>
<td>–</td>
</tr>
<tr>
<td>Procedure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CABG</td>
<td>Ref</td>
<td>–</td>
</tr>
<tr>
<td>AVR</td>
<td>1.22 0.70–2.11 0.49</td>
<td>0.92 0.48–1.75 0.80</td>
</tr>
<tr>
<td>CABG and AVR</td>
<td>0.99 0.49–1.10 0.97</td>
<td>0.81 0.37–1.79 0.61</td>
</tr>
<tr>
<td>MVR</td>
<td>0.38 0.08–1.96 0.25</td>
<td>0.65 0.32–1.34 0.62</td>
</tr>
<tr>
<td>CABG and MVR</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Other</td>
<td>0.35 0.13–0.91 0.03</td>
<td>0.19 0.06–0.60 0.01</td>
</tr>
<tr>
<td>Length of ICU stay</td>
<td>≤1 day Ref</td>
<td>–</td>
</tr>
<tr>
<td>3–4 days</td>
<td>0.91 0.56–1.47 0.70</td>
<td>–</td>
</tr>
<tr>
<td>≥5 days</td>
<td>1.56 0.74–3.31 0.25</td>
<td>–</td>
</tr>
<tr>
<td>GCS after 24 h</td>
<td>0.89 0.73–1.09 0.26</td>
<td>–</td>
</tr>
<tr>
<td>Highest creatinine μmol/l</td>
<td>1.01 1.04–1.02 &lt;0.01</td>
<td>1.02 1.01–1.03 &lt;0.001</td>
</tr>
</tbody>
</table>

*aFunctional status at baseline based on the modified Katz ADL index questionnaire (15 items).

*bCognitive function at baseline based on IQCODE-SF.

*cGroup too small for analysis.

GCS, Glasgow Coma Score
factor for functional decline after cardiac surgery [26], as is female gender [26].

Cognitive impairment was found to be a very strong predictor of functional decline 12 months after hospital discharge. Several studies support that pre-existing cognitive impairment is a significant determinant of whether deficits are observed after CABG and endorse the importance of investigating pre-operative cognitive function [27, 28].

Some limitations of the study should be noted. First, the study was performed at a single tertiary care centre, which may limit generalisability. Secondly, we only included patients admitted for an elective procedure and therefore the results might not be generalisable to acutely admitted patients. Thirdly, we did not measure if cardiothoracic surgery gave a reduction of the other symptoms, which also influences quality of life.

In conclusion, the outcomes for patients that have undergone cardiothoracic surgery are good considering the survival rates. There is an overall decline in daily functioning 1 year after surgery. The results might indicate that studies on geriatric rehabilitation before and after surgery are needed to see whether the trajectory of this functional decline could be influenced.

**Key points**

- Survival rates after cardiothoracic surgery are good for older people.
- Many people face new disabilities after cardiothoracic surgery.
- Rehabilitation might prevent or restore disabilities and more studies are needed to demonstrate this effect.

**Acknowledgements**

The authors wish to thank Jose de Koning-Popma, research nurse, for her contribution to the data collection.

**Author's contributions**

All authors had access to the study data and participated in analysis or interpretation of the data (or both) and preparation of the manuscript.

**Conflicts of interest**

None declared.

**Funding**

This study was funded by an unrestricted grant from AGIS health care insurance.

**Supplementary data**

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

**References**


Received 16 July 2013; accepted in revised form 12 February 2014